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Full Length Research Paper

Influence of Ascorbic acid on the Quality of Wheat and Soybean based Breads

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The work assessed the influence of ascorbic acid on the proximate composition, physical and sensory attributes of wheat and soybean based breads. The samples used in the work were WAF (Wheat/0.00g Ascorbic acid), WSA_1 (Wheat / Soybean / 0.10g Ascorbic acid), WSA_2 (Wheat / Soybean / 0.15g Ascorbic acid), WSA_3 (Wheat / Soybean / 0.20g Ascorbic acid), WSA_4 (Wheat / Soybean / 0.25g Ascorbic acid), and WSA_5 (Wheat / Soybean / 0.30g Ascorbic acid). The proximate analysis revealed that protein, fat, crude fibre, ash and moisture content increased as the level of ascorbic acid increased. The result also indicated that protein increased from 8.76% to 14.30%, fat (10.77 – 14.74%), crude fibre (1.36 – 2.54%), ash (1.48 – 2.76%) and moisture content (31.52 – 35.15%) respectively. However, there was a decrease (46.11 – 30.51%) in the carbohydrate content. The thiobarbituric acid (TCA) values of the bread increased sharply at ambient temperature (28^{0}C) as the storage days increased while the TBA values increased gradually at freezing (-14^{0}C) and refrigeration (10^{0}C) temperatures until the 14th (last) day. The sensory evaluation indicated that the breads with less than 0.25g ascorbic acid were more acceptable organoletpically than those containing above 0.25g ascorbic acid.

Keywords: Ascorbic acid, proximate composition, physical analysis, thiobarbituric acid (TBA), sensory evaluation.

INTRODUCTION

In ancient times, bread like and past a like food products have been made form flours of cereals, pulses and tubers. Bread which can be defined as a baked and leavened food made of a mixture whose major constituent is flour (Akobundu, 2006) was one of the few foods that sustained the poor through the dark ages (Tannahill, 1973). The use of wheat for human consumption is increasing considerably and there is an objective on how to seek possibilities for the use of raw materials other than wheat in the production of bread, pasta and similar flour based foods (Edem *et al.,* 2005). The promotion, formulation and the use of composites (flour mixtures) consisting mainly of indigenously (locally) grown food crops or raw materials with high protein content (composition) that can combine optimal nutritive value with good quality to replace a portion of the wheat flour in breadmaking have been intensified (Kwon *et al.,* 1976; Olaoye *et al.,* 2006).

Mattews *et al.* (1970) explored the possibilities offered by various oil seed flours (sesame seed, sunflower seed, soybean, etc) in composite bread production because of their high water absorption. The combination of wheat, cocoyam and potato flours had been used to produce

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composite bread of high loaf volume (Okorie, *et al.,* 2002). More recently, chemical additives are used as improvers in breadmaking. Researchers have introduced the use of ascorbic acid as a replacement for potassium bromate (Okaka, 2005). Ascorbic acid is one of the naturally occurring reducing substances and an effective dough developer that speeds up mixing time and reduces fermentation time when added to dough during breadmaking (Deha *et al.,* 1986).

However, this work was aimed at ascertaining the influence of ascorbic acid on the quality of wheat and soybean based breads.

MATERIALS AND METHODS

Material collection

Wheat flour (Golden penny brand), fat, sugar, Salt and instant yeast (Baker's Yeast) were purchased at Owerri main market (Ekonuwa), Imo State. Soybean was obtained at Imo State Polytechnic, Umuagwo. Ascorbic acid was purchased at Kentin laboratory, Owerri, Imo State.

Processing of soybean into soybean flour

The method according to IITA (1990) was adopted, a method that ensured an effective removal of most anti-nutrients. The soybeans were sorted, washed, soaked in water (1:3 volume) for about 2hrs. The soaked seeds were strained and boiled for 25mins to blanch the seeds. The seeds were dried in a hot oven (Gallenkamp), crushed and winnowed manually to remove the chaff. The seeds were milled into flour using an attrition mill and finally sundried using a solar drier. The dried flour was sieved (60mm mesh size) to separate the coarse particles from the fine soy flour. The flour was packaged in an air-tight polyethylene bag.

Wheat-soybean composite bread production

The straight dough method and the recipe for the wheat - soybean composite bread production as described by Oti and Aniedu (2006) was used. Six (6) sample formulations were prepared and baked. The quantities of wheat flour, soybean flour, sugar, salt, margarine, instant yeast and water remained constant while the ascorbic acid levels varied (Table 1). All the ingredients were measured into a clean mixing aluminum bowl and mixed thoroughly. The fat was rubbed in, water was added, then it was further mixed until a consistent dough formed. This dough was kneaded, moulded into a loaf and placed in a loaf pan which had been greased with fat. The dough was left to proof until it doubled it's size and then finally baked in an oven at 230^0C for about 45mins (or until the crust was golden yellow). After baking, the loaf was removed from the pan, placed on a table to cool and then packaged in a polyethylene bag.

Physico-chemical analysis

The crude protein, fat, crude fibre, ash and moisture content were determined by the method described by AOAC (2000) and James (1995) while the carbohydrate content was by the difference method. Thiobarbituric acid (TBA) was determined by the method of Pearson (1976). The bread (loaf) and specific volumes were determined according to the method of Onwuka (2005).

Statistical analysis

The data obtained in this work was statistically analyzed using the Analysis of Variance (ANOVA). The means were separated using Fisher's Least Significance Difference (LSD) (Steele and Torrie, 1996).

RESULTS AND DISCUSSION

Proximate composition

The results of the proximate composition (Table 2) indicated that the protein content, crude fibre, ash, fat and moisture content increased significantly ($P<0.05$) except the carbohydrate content. The values obtained were crude protein (8.76±0.03 – 14.30% ± 0.02), crude fibre (1.36±0.01 – 2.54% ± 0.04), ash (1.48 ± 0.01 – 2.76% ± 0.06), fat (10.77 ± 0.04 – 14.74% ± 0.02) and moisture content (31.52±0.02 – 35.15%±0.03) for WAF to WSA_5 respectively. The increase in protein content could be as a result of the significant quantity of protein contributed by soybeans when added to the wheat (Olaoye *et al.,* 2006). However, carbohydrate content decreased from 46.11±0.06 to 30.51% ± 0.13. The decrease in carbohydrate content was as a result of the addition of soybean flour and reduction of wheat flour in the composite bread.

There were significant differences ($P<0.05$) between WSA_5 and WAF, WSA_1, WSA_2, WSA_3 and WSA_4 in protein, moisture, ash and fat contents, while there were no significant differences ($P>0.05$) between WSA_4 and WSA_5 and also between WSA_2 and WSA_3 in crude fibre content. Sample WSA_1 and WSA_2 compared well ($P>0.05$) in carbohydrate content. The result further indicated that there was significant difference ($P<0.05$) between WAF and other bread samples but no significant differences ($P>0.05$) existed between WSA_1 and WSA_2 in ash and fat contents.

Table 1. The recipe for wheat and soybean composite bread production with varied ascorbic acid levels.

Ingredients	WAF	WSA_1	WSA_2	WSA_3	WSA_4	WSA_5
Wheat flour(g)	500	450	450	450	450	450
Soybean flour (g)	-	50	50	50	50	50
Sugar (g)	50	50	50	50	50	50
Salt (g)	1tp	1tp	1tp	1tp	1tp	1tp
Ascorbic acid (g)	0.0	0.10g	0.15g	0.20g	0.25g	3.00g
Instant yeast (g)	20	20	20	20	20	20
Margarine (g)	50	50	50	50	50	50
Water (ml)	275	275	275	275	275	275

1tp = one teaspoon (0.00g)
WAF = 100% Wheat flour/Ascorbic acid
WSA_1 = Wheat/Soybean/0.10g Ascorbic acid
WSA_2 = Wheat/Soybean/0.15g Ascorbic acid
WSA_3 = Wheat/Soybean/0.20g Ascorbic acid
WSA_4 = Wheat/Soybean/0.25g Ascorbic acid
WSA_5 = Wheat/Soybean/0.30g Ascorbic acid

Table 2. Mean values for the proximate composition of wheat and soybean based breads

Ingredients	WAF	WSA_1	WSA_2	WSA_3	WSA_4	WSA_5
Carbohydrate	46.11 ± 0.06^a	41.46 ± 0.05^b	40.47 ± 0.40^b	37.10 ± 0.80^c	33.86 ± 0.14^d	30.51 ± 0.13^e
Protein	8.76 ± 0.03^f	11.40 ± 0.02^e	11.62 ± 0.03^d	12.51 ± 0.05^c	12.87 ± 0.01^b	14.30 ± 0.02^a
Moisture	31.52 ± 0.02^e	31.79 ± 0.03^{de}	32.48 ± 0.04^{cd}	32.63 ± 0.05^c	33.66 ± 0.05^b	35.15 ± 0.03^a
Ash	1.48 ± 0.01^d	1.63 ± 0.04^c	1.67 ± 0.03^c	2.69 ± 0.08^b	2.74 ± 0.02^{ab}	2.76 ± 0.06^a
Crude fibre	1.36 ± 0.01^c	1.41 ± 0.03^{bc}	1.45 ± 0.01^b	1.46 ± 0.03^b	2.50 ± 0.02^a	2.54 ± 0.04^a
Fat	10.77 ± 0.04^e	12.31 ± 0.02^d	12.34 ± 0.01^d	13.61 ± 0.05^c	14.36 ± 0.03^b	14.74 ± 0.02^a

Mean Values ± standard deviations in the same column with the same superscript are not significantly different ($P<0.05$)

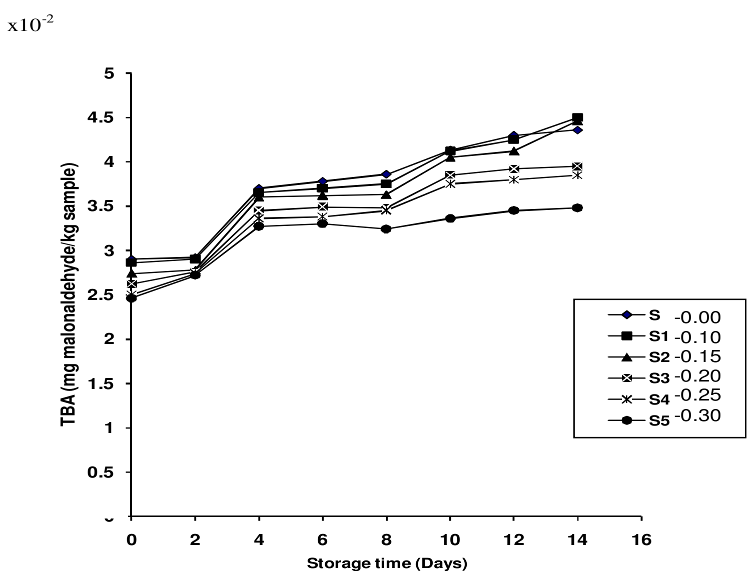

Figure 1. Changes in thiobarbituric acid (TBA) of bread from wheat soybean composite flour with varied ascorbic acid levels stored at ambient temperature (28^{0}C)

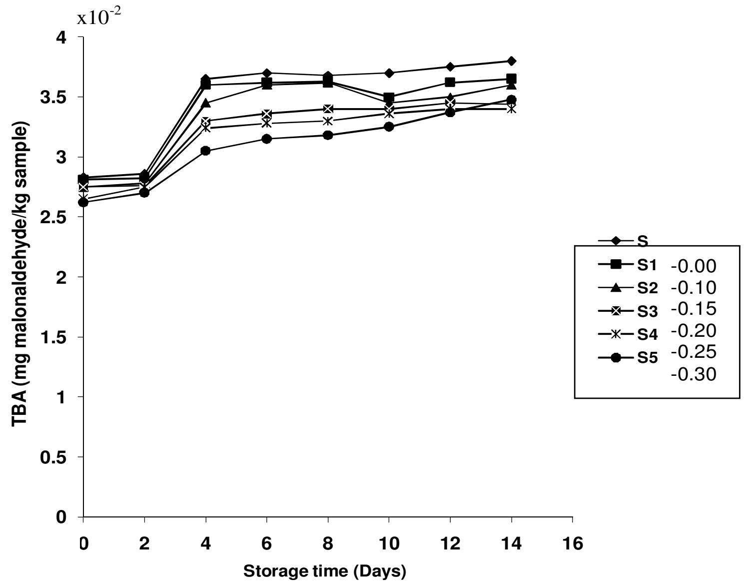

Figure 2. Changes in thiobarbituric acid (TBA) of bread from wheat soybean composite flour with varied ascorbic acid levels stored at freezing temperature (-14^{o}C).

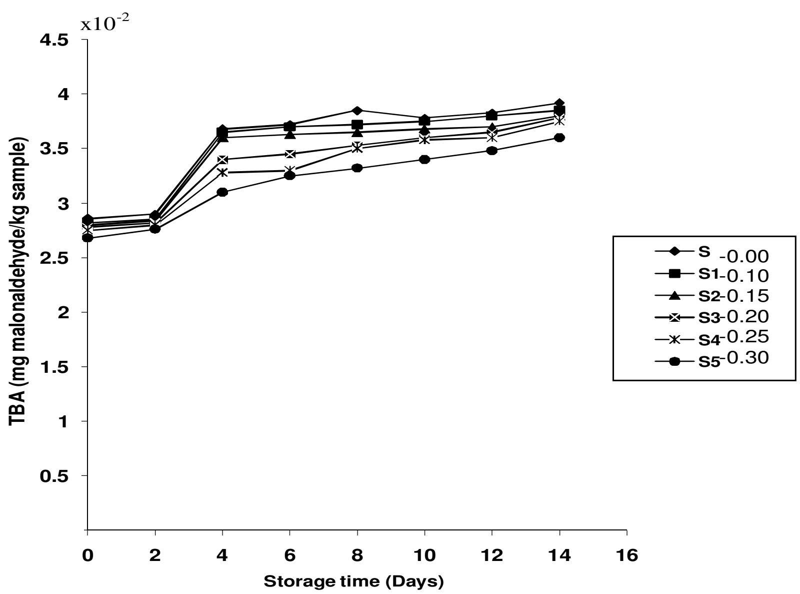

Figure 3. Changes in thiobarbituric acid (TBA) of bread from wheat soybean composite flour with varied ascorbic acid levels stored at Refrigeration temperature (10^{0}C).

Thiobarbituric acid (TBA)

The TBA values obtained in the analysis indicated that there were increases in TBA values as the ascorbic acid level increased at ambient temperature (28^{0}C) from the first day to the 4th day and then increased sharply until the 14th (last) day of storage (Figure. 1).

The same pattern of increases (although slowly) in TBA values from the first day to the 4th day of storage was observed in the refrigeration (10^{0}C) and freezing (-14^{0}C) storages. As the storage days increased, the TBA values almost remained constant in their increases (Figures. 2 and 3).

The sharp increase in TBA values as the ascorbic acid increased indicated increased lipid peroxidation in the bread products during storage at ambient temperature while at refrigeration and freezing storages, the slow increases were as a result of reduced lipid peroxidation.

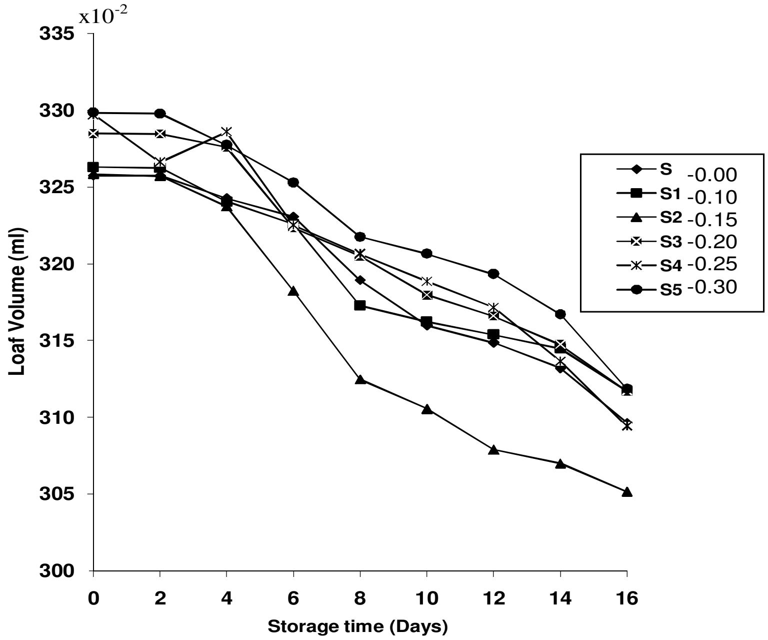

Figure 4. Changes in the volume of bread from wheat soybean composite flour with varied ascorbic acid levels.

WSA_5 showed the least increase in TBA value at the three different temperatures.

Physical properties

The bread (loaf) volume of WSA_5 which had the highest level (0.30g) of ascorbic acid was the highest (329.85ml) on the first day of storage. The volumes of the bread (loaf) samples decreased sharply as the storage days increased but WSA_2 indicated a sharp decrease in volume as the storage days increased to 16 days (Figure. 4). It was to be noted that the bread (loaf) volumes were quite high on the first day of storage but only decreased as the storage days increased. High bread (loaf) volume of composite bread using potato peels, potato flour and mashed potatoes (Burton, 1989) and potato, cocoyam and wheat flours (Okorie *et al.,* 2002) respectively at different substitutions had been reported.

These increases in bread volumes were due to the effect of ascorbic acid which assisted the yeast to produce amylolytic enzymes that broke down simple sugars to produce more fermentable substrates for the increased rate of fermentation. Poor bread volumes of WSA_2 (307.90, 307.00 and 305.15ml) on the 12, 14 and 16^{th} days of storage and WSA_4 (309.42ml) on the 16^{th} day may be due to poor gas retention, an indication of the low extensible nature of the gluten content.

The result also showed that the specific volume of the breads decreased gradually with increase in ascorbic acid level as the storage days increased (Figure. 5). However, WSA_5 with the highest (0.30g) ascorbic acid level had the highest (4.22ml/g) specific volume.

Sensory evaluation

There were significant differences (P<0.05) in appearance, flavour/aroma, taste, crumb texture and overall acceptability between WAF and other bread samples except in crust colour where WAF, WSA_1, WSA_2 and WSA_3 compared well (P>0.05). Also, WSA_4 and WSA_5 showed no significant difference (P>0.05) in crust colour (Table 3). The same pattern of no significant difference (P>0.05) was observed between WSA_1, WSA_2, WSA_3, WSA_4 and WSA_5 in flavour/aroma, taste and crumb texture on one hand and between WSA_1, WSA_2, WSA_3 and WSA_4 in appearance and overall acceptability on the other hand.

CONCLUSION

This work had shown that acceptable bread can be produced using wheat and soybean flours at different substitutions and treating the composite flour with different levels of ascorbic acid. The proximate composition of the

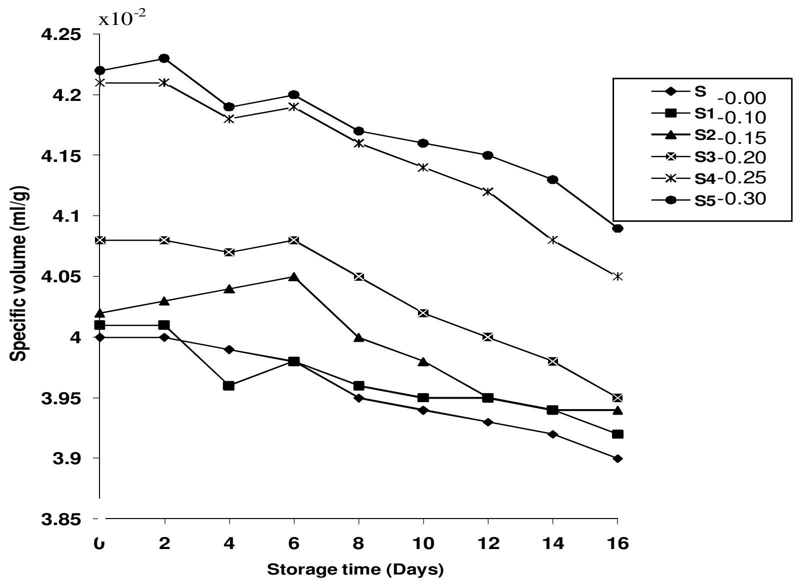

Figure 5. Changes in Specific Volume of bread from wheat soybean composite flour with varied ascorbic acid levels.

Table 3. Mean values of the sensory evaluation on wheat and soybean based breads

Bread samples	Appareance	Flavour/ Aroma	Taste	Crust Colour	Crumb Texture	Overall Acceptability
WAF	7.90±0.79^{a}	7.75±0.85^{a}	8.0±0.58^{a}	6.70±0.74^{a}	7.75±0.90^{a}	8.45±0.73^{a}
WSA_1	6.20±0.86^{b}	5.60±1.01^{b}	5.15±1.28^{b}	6.30±0.78^{a}	6.35±0.70^{b}	5.95±1.01^{b}
WSA_2	6.10±1.16^{b}	5.50±1.07^{b}	4.80±1.46^{b}	6.20±1.06^{ab}	6.25±1.07^{b}	5.85±1.02^{b}
WSA_3	6.10±1.13^{b}	5.45±1.07^{b}	4.65±1.33^{b}	6.20±1.08^{ab}	6.20±1.37^{b}	5.80±1.32^{b}
WSA_4	5.58±1.23^{b}	5.20±1.32^{b}	4.60±1.32^{b}	5.50±0.83^{b}	6.05±1.09^{b}	5.40±1.19^{bc}
WSA_5	4.60±1.33^{c}	5.15±0.96^{b}	4.50±1.30^{b}	5.40±1.34^{b}	5.15±1.06^{b}	4.85±1.44^{c}

Mean Values ± standard deviations in the same column with the same superscript are not significantly different level (P<0.05).

breads indicated that the protein, fat, crude fibre, ash, moisture content and carbohydrate increased and the ascorbic acid also improved the bread nutritionally.

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